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Bell

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(54) **THERMOELECTRIC PERSONAL ENVIRONMENT APPLIANCE**

(75) Inventor: **Lon E. Bell**, Altadena, CA (US)

(73) Assignee: **BSST LLC**, Irwindale, CA (US)

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(51) **Int. Cl.**
F25B 21/02 (2006.01)

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See application file for complete search history.

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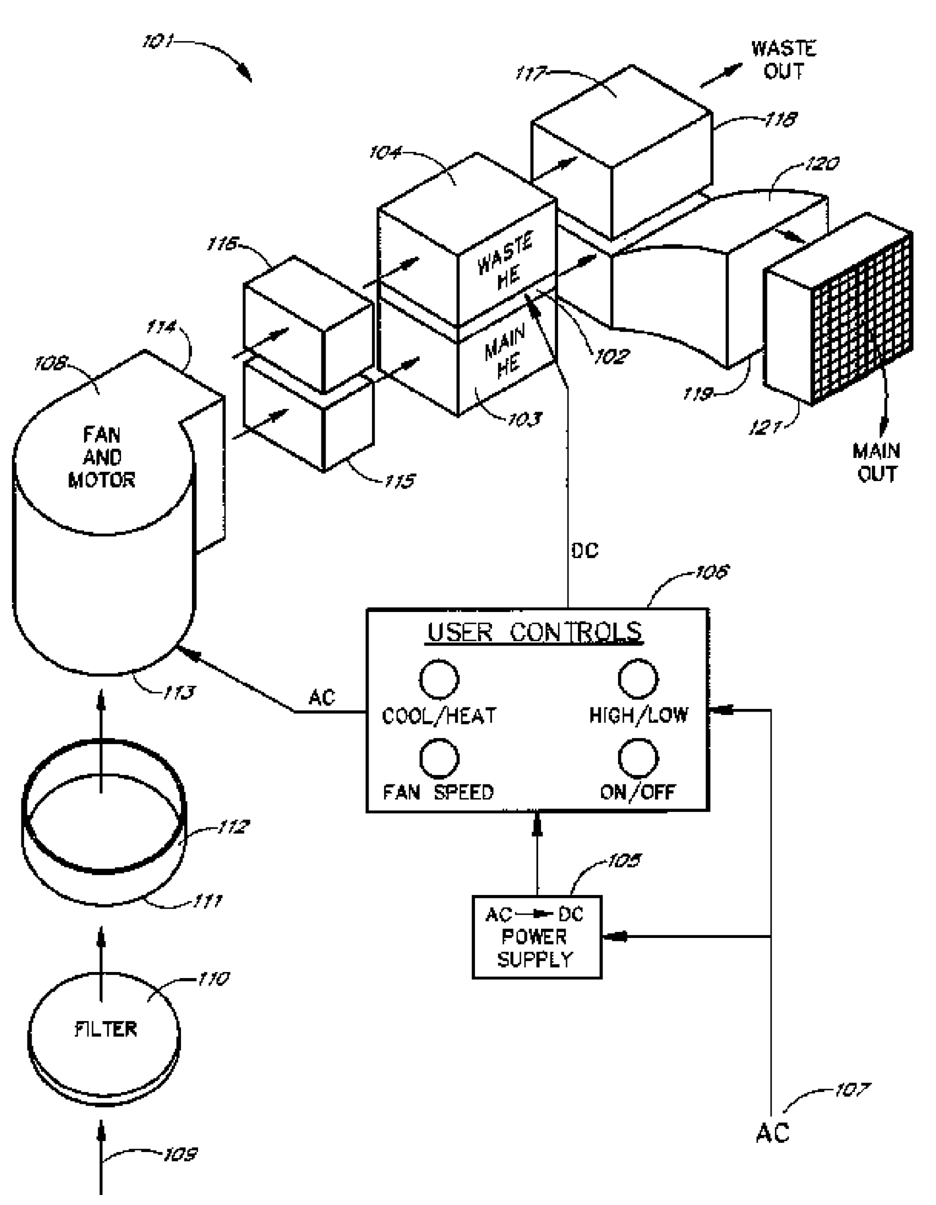
Primary Examiner — Mohammad Ali
(74) *Attorney, Agent, or Firm* — Knobbe, Martens, Olson & Bear, LLP

(57) **ABSTRACT**

A personal environment appliance is disclosed in which a person in a localized area can individually control the ambient conditions of the person's localized area. The control permits highly localized adjustment to suit individual preferences, thereby, reducing the impact of individual environmental preferences on the individuals. In addition to environment conditions, a variety of accessories may be provided such as beverage heaters and/or coolers.

16 Claims, 5 Drawing Sheets



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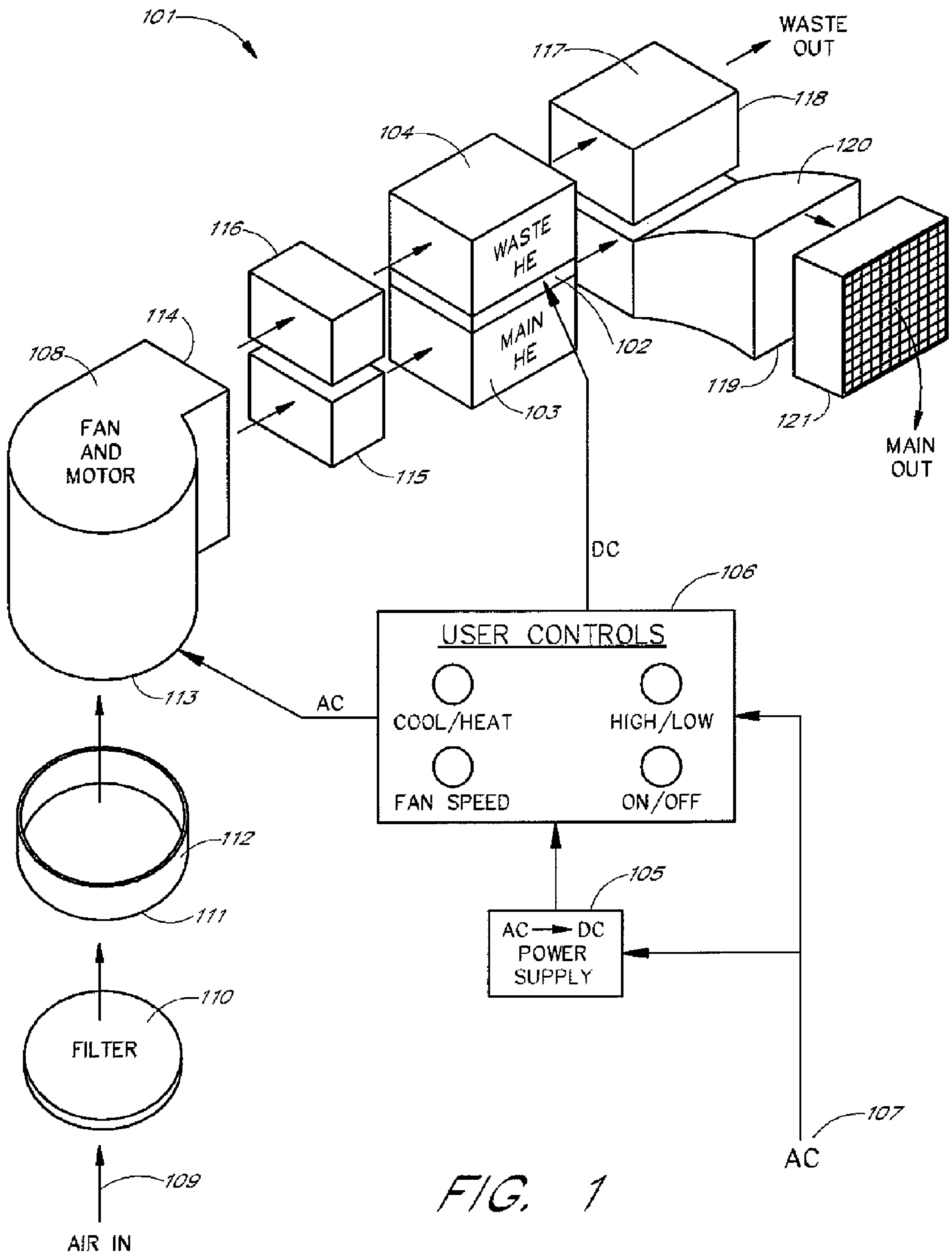
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FIG. 1

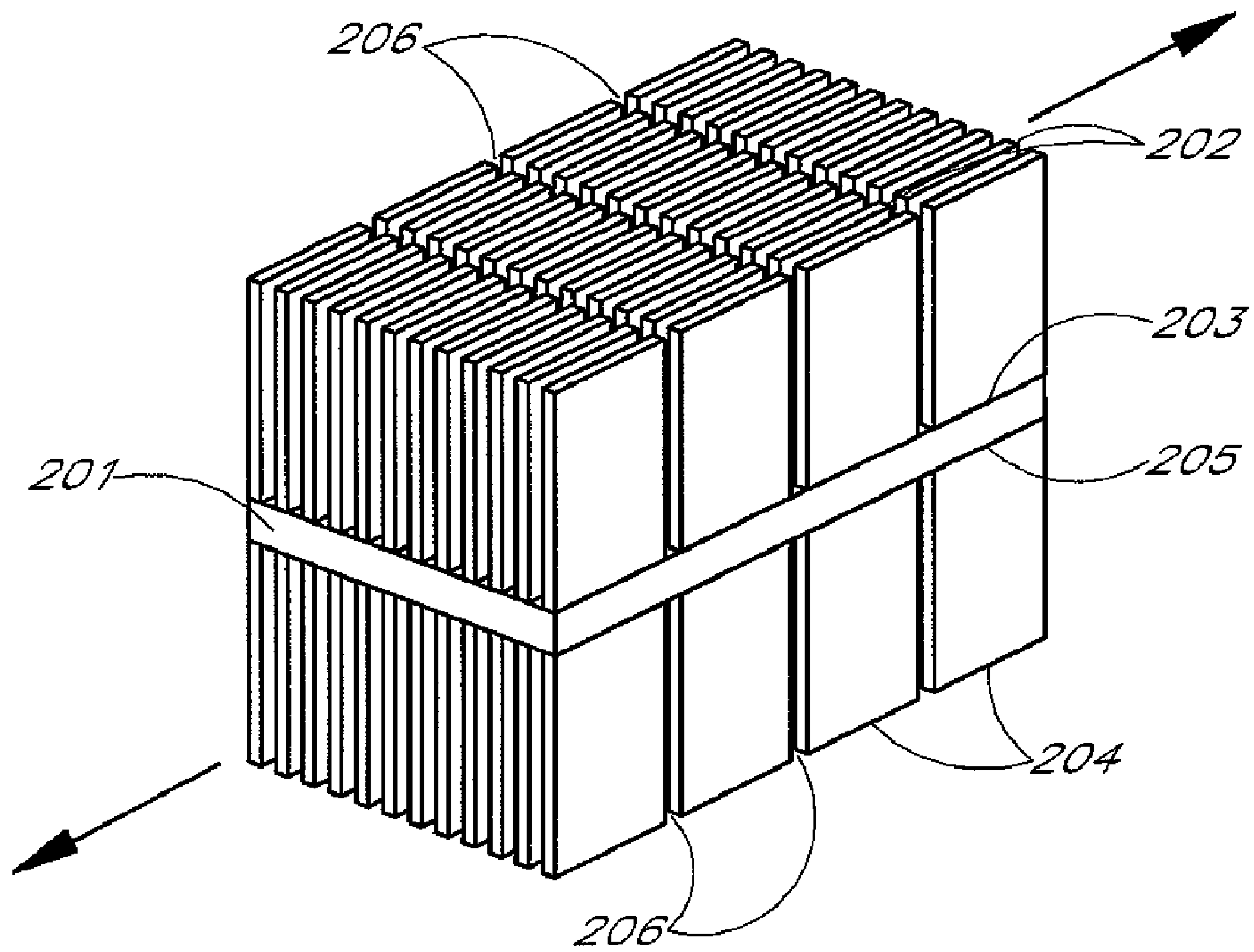

FIG. 2

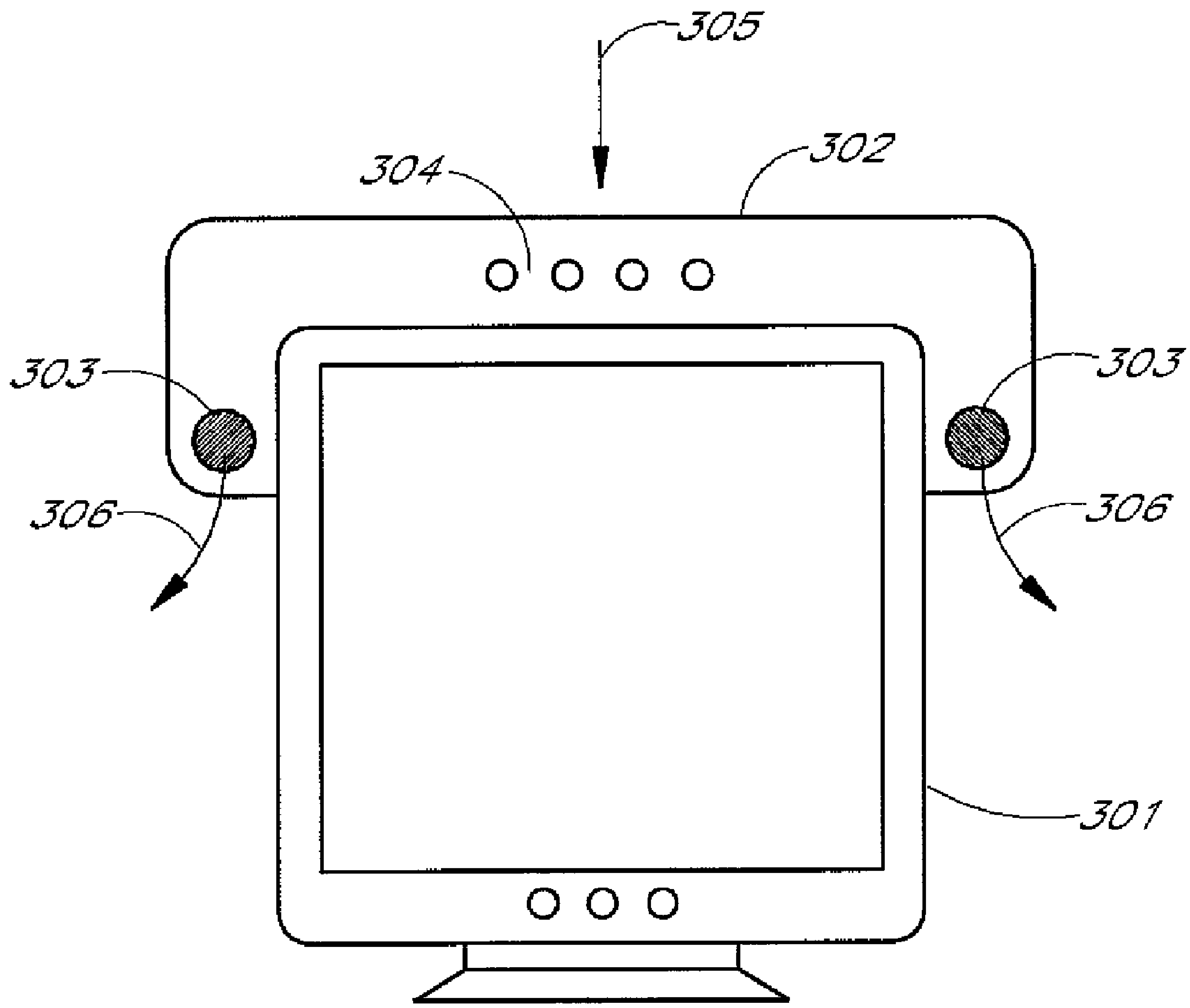

FIG. 3

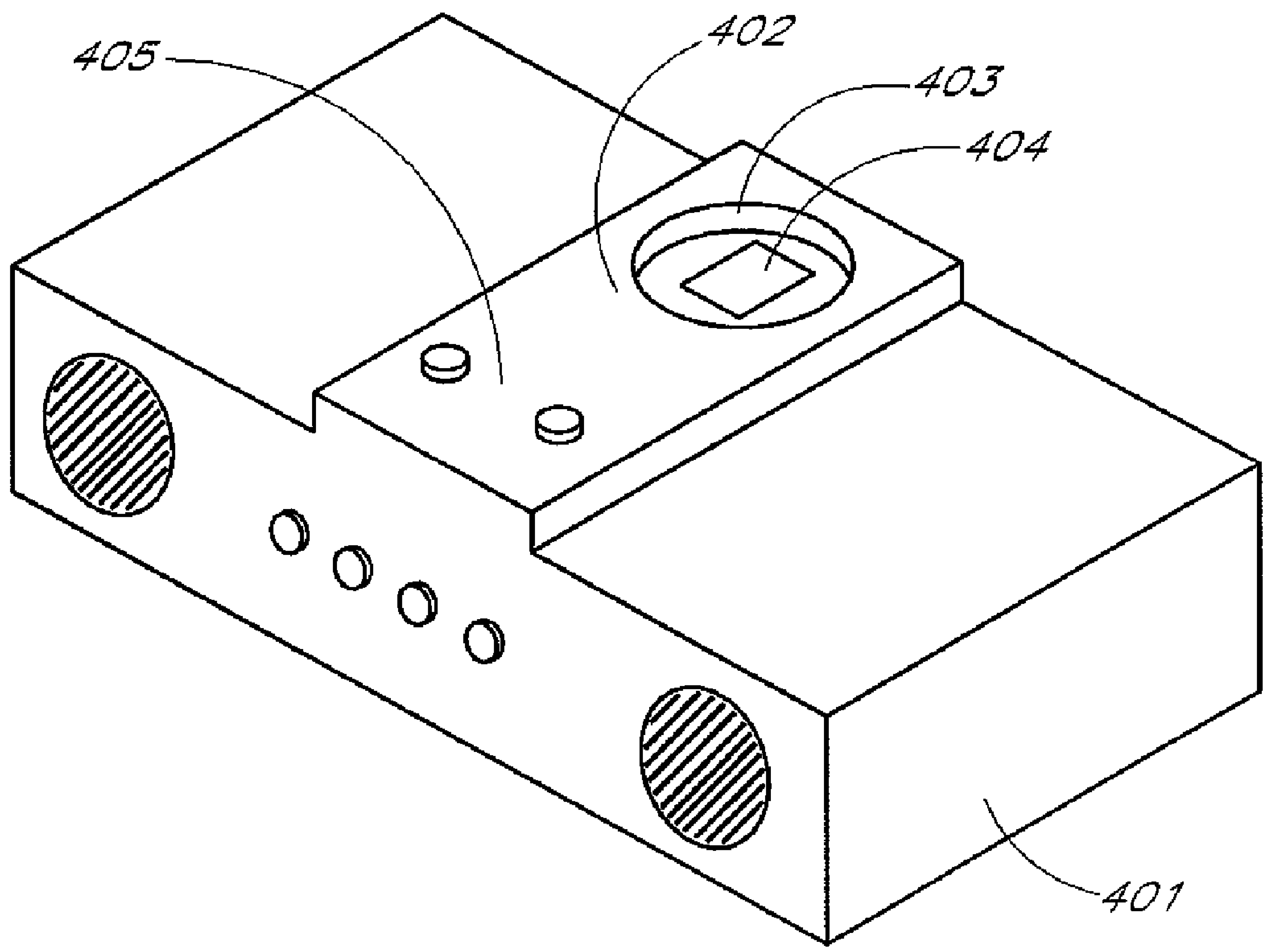

FIG. 4

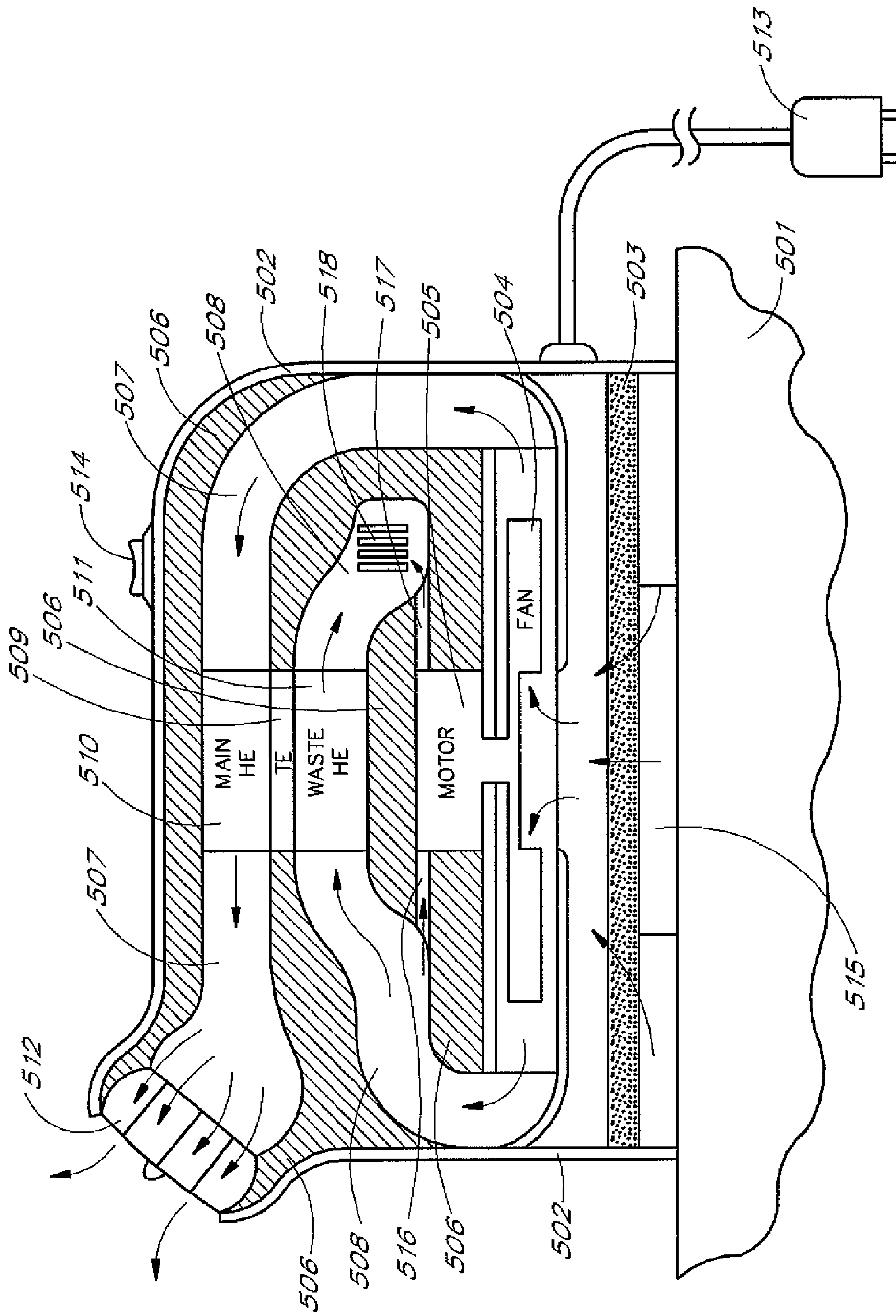
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FIG. 5

THERMOELECTRIC PERSONAL ENVIRONMENT APPLIANCE

CLAIM OF PRIORITY

This application is a continuation from U.S. patent application Ser. No. 10/215,163, filed Aug. 7, 2002 now U.S. Pat. No. 7,426,835 and incorporated in its entirety by reference herein, which claims the benefit of U.S. Provisional Patent Application No. 60/310,565, filed Aug. 7, 2001.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to heating and air conditioning and, more particularly, is concerned with providing localized thermal comfort in the workplace. In addition, the invention can also be applied in many circumstances in living areas of homes and apartments. The deployment and use of the invention is similar to that in the workplace, being focused on individual localized comfort.

2. Description of the Related Art

Generally, where work places or dwelling are climate controlled, the climate control is provided by large compressor-based systems to large zones encompassing many individual work areas. This situation results in high costs of conditioning the spaces not occupied and also forces within a single controlled zone to accept that climate output whether or not it satisfies an individual's preference or sense of comfort. Further, such control over large zones is not uniform, so that some present are exposed to areas that are hot while others are too cold.

Compressor-based systems for individual climate control are impractical because of their size, cost, and noise output. Others have addressed the need for individual climate control using thermoelectric devices. For example U.S. Pat. No. 5,193,347 discloses a helmet with a thermoelectric cooler supplying a cool breeze to the face of the wearer. Such systems are not suitable for most practical work or dwelling situations. Another example is the system described in U.S. Pat. No. 4,905,475. In its description, the patent presents a system with airflow directed to the head and neck of the individual, and with only rudimentary control over the air temperature produced. Many workers, particularly those with sedentary jobs, have a need for more individualized climate control using an appliance not so intimately and closely coupled to their person as are present systems.

SUMMARY OF THE INVENTION

With appropriate technology, providing individual localized area climate control requires a small power input to achieve easily discernible effects on the individual. Zonal climate control temperatures may be adjusted to reduce the power required for overall space climate control and individual localized area climate control appliances used to fine-tune the environment for each individual. Overall, such systems will save energy. One example is using thermoelectric devices as described in the present application, which are advantageous because they are small, quiet, and can be quite efficient when employed properly.

Individualized climate control also will increase productivity, not only because the individuals can choose the temperature most comfortable to them, but because they are empowered to make the choice.

Therefore, one aspect of the present invention is to provide localized personal comfort to individuals with a range of controllability built into a device that is not intrusive to them or obstructive to their normal work or other environment. Preferably, localized control for the temperature in the proximate vicinity of one or more individuals. This is distinguished from mobile cooling systems, such as individually cooled and heated seats, which more directly cool or heat the seat occupant as opposed to the local environment. Preferably, the local workspace environment is controllable. A further object of this invention is to augment a personal environment appliance with additional features useful to an individual and synergistic with its fundamental design. Such features include localized air filtration, small area lighting, beverage heating/cooling, small personal refrigerator, and calming auditory environment.

The system described herein is generally intended for non-mobile applications, but could be implemented in a mobile environment or workspace or work area setting.

One aspect of the present invention involves a personal environment appliance that provides heating and/or cooling in a localized area, such as a work area. The appliance generally has at least one electric motor driving at least one fan, at least one inlet air path to a low pressure side of the at least one fan, at least one thermoelectric device, at least one main side heat exchanger in thermal communication with the at least one thermoelectric device, wherein inlet air passes the heat exchanger and changes temperature, and at least one outlet for air that has passed the heat exchanger to provide temperature control of the local area.

In one embodiment, the at least one insulative insert is enclosed within a housing and is shaped to provide at least one air pathway. For example, the at least one insulative insert is shaped to form the at least one inlet air path.

In one embodiment, an air filter is provided, preferably demountably so it can be replaced. Preferably, at least one flow directing device is provided for the outlet. In one embodiment, at least one AC to DC power supply is provided to supply electricity to the thermoelectric.

In one embodiment, a user operable control is provided. Preferably, the user operable control adjusts the air flow rate, and/or the amount of heating or cooling, and/or selects cooling, heating, operation of the fan without heating or cooling, and off.

The appliance may be constructed to rest on a surface, to be suspended from a surface, or to be attached to a surface. In one embodiment, the appliance is configured to mount on a computer monitor. In such an embodiment, an anti-glare screen may be provided.

In one embodiment, a light is included, such as a work surface light. In another embodiment, a sound generator is provided. The sound generator may generate white noise or other distraction eliminating, and may also provide active noise cancellation.

In one embodiment, the appliance include a thermoelectric beverage cooler and heater. A holder for desk implements and supplies may also be a part of the appliance.

In another embodiment, a thermoelectric refrigerator may be built into the appliance.

For improved efficiency, preferably, at least some of the at least one thermoelectric devices employ thermal isolation in the direction of flow.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** depicts a schematic diagram of a thermoelectric personal environment appliance;

FIG. **2** illustrates the thermoelectric device and heat exchanger portion of the thermoelectric personal environment appliance in which thermal isolation in the direction of flow is employed to improve performance and efficiency;

FIG. **3** illustrates a thermoelectric personal environment appliance on a computer monitor;

FIG. **4** illustrates the addition of a beverage cooler and heater to the thermoelectric personal environment appliance;

FIG. **5** depicts one embodiment of a thermoelectric personal environment appliance intended for use on a surface.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the context of this description, the term Thermoelectric Module or TE Module are used in the broad sense of their ordinary and accustomed meaning, which is (1) conventional thermoelectric modules, such as those produced by Hi Z Technologies, Inc. of San Diego, Calif., (2) quantum tunneling converters (3) thermoionic modules, (4) magneto caloric modules, (5) elements utilizing one, or any by combination of, thermoelectric, magneto caloric, quantum tunneling and thermoionic effects, and (6) any combination, array, assembly and other structure of (1) through (5) above.

In this description, the words cold, hot, cooler, hotter and the like are relative terms, and do not signify a particular temperature or temperature range. In addition, the embodiments described in this application are merely examples, and are not restrictive to the invention, which is defined in the claims.

FIG. **1** is a schematic diagram of a personal environment appliance **101**. A thermoelectric module **102** is in good thermal communication with a main side heat exchanger **103** and a waste side heat exchanger **104**. The good thermal communication is achieved, for example, using thermal grease or a thermally conductive epoxy. As shown, the heat exchangers **103** and **104** are straight finned heat exchangers although many other types of heat exchangers may be used. DC power is supplied to the TE module **102** by the power supply **105** as selected by the settings (on/off, cool/heat, and high/low) of the user controls **106**. The power supply **105** is preferably a switching power supply to maximize efficiency and minimize cost and weight. The power supply **105** may be either internal to the appliance or may be external with suitable electrical cabling connecting the power supply **105** with the user controls **106**. The input to the power supply is AC power **107** delivered through a suitable cord and plug (not shown). AC power **107** is also provided though the user controls **106** (on/off and fan speed) to an electric motor driven fan **108**. Other sources of power are also acceptable. As shown, the electric motor driven fan is a composed of a single motor and a single fan blade. Depending upon the amount of air flow required and the pressure differential that must be produced, multiple fan blades can be mounted on the shaft or multiple shaft motors can be used. Alternately, two completely separate fan blade and motor assemblies can be used. Although a DC fan could also be used, the fan motor is preferably a two or three speed AC motor to minimize the capacity needed from the DC power supply **105**. A DC fan could also be used.

The fan **108** pulls fresh air **109** through a filter **110** (preferably replaceable) located at the fresh air inlet port **111** and through a duct **112** to the low-pressure side **113** of the fan **108**. Air exits the high pressure side **114** of the fan **108** and passes through both the main side air input duct **115** and the waste side input duct **116** which are connected to the main side heat exchanger **103** and the waste side heat exchanger **104** respectively. Advantageously, to maximize the performance of the appliance and the comfort to the user, the air flow through the main side should be approximately 5 to 10 CFM while that on the waste side should be somewhat more, preferably from 1.5 to 3 times the main flow. The air flow from the waste side heat exchanger **104** passes through the waste side output duct **117**, exiting the appliance at the waste outlet port **118**, preferably pointing away from both the fresh air port **111** and the main outlet port **119**. The waste may also be vented outside, to another room, or into a crawl or attic space, or the like. The airflow from the main side heat exchanger **103** passes through the main side output duct **120** and through a flow-directing device **121** such as one with adjustable louvers or one with fixed vanes within a ball directionally adjustable in socket, as examples.

As air passes through the main side heat exchanger **103**, its temperature is changed from that of the air entering by the amount and in the direction as selected by the user controls **106**. As air passes through the waste side heat exchanger **104**, its temperature is changed in the opposite direction. Thus, the temperature of the air exiting the main side is cooler if the user has selected cooling mode, and warmer if the heating mode is selected with the amount of temperature differential determined by the user's selection of high or low. As shown, the adjustment of the amount of temperature change has only two discrete levels. Any number of discrete levels may be used, or the adjustment may be continuous. This control may also be combined with the on/off switch into a physically single control.

Preferably, the ducts **112**, **115**, **116**, **117**, and **120** are made of thermally insulative material. As shown in FIG. **1**, they are separate parts. They are advantageously constructed from one or more insulative inserts shaped to provide necessary ducts along with cavities in which the fan assembly, the TE module with the heat exchangers, and the flow-directing device may rest.

The performance of the personal environment appliance may be improved by modifications to the thermoelectric module and heat exchanger portion as shown in FIG. **2**. This modification is to provide thermal isolation in the direction of flow as described in U.S. patent application Ser. No. 09/844,818, filed on Apr. 27, 2001, published as U.S. Patent Publication No. US2002/0139123 A1 on Oct. 2, 2002, and issued as U.S. Pat. No. 6,539,725 on Apr. 1, 2003. This patent application is incorporated by reference herein.

The thermoelectric module **201** is in good thermal contact with a plurality of heat exchangers **202** on its main side **203** and in good thermal contact with a plurality of heat exchangers **204** on its waste side **205**. As shown in FIG. **2**, the heat exchangers are fin structures. Other types of heat exchangers can be used instead. The good thermal contact with the thermoelectric module is achieved with thermal grease or with thermally conductive glue. If grease is used, it is necessary to provide a clamping force holding the heat exchangers **202** and **204** firmly against the TE module **201**. The heat exchangers **202** on the main side **203** are separated from each other by gaps **206** as are the heat exchangers **204** on the waste side **205**. The main **203** and waste **205** sides of the TE module **201** are typically made of a ceramic material. Because of the sufficiently low thermal conductivity of the sides **203** and **205** of the TE module **201**, along with the presence of the gaps **206**, an acceptable amount of thermal isolation from one heat exchanger to the next is achieved. The arrows in the diagram show the flow direction. Preferably the flow is counter-flow with the main and waste flows in opposite directions. However, this is not necessary, and flow from the same direction is also possible.

The personal environment appliance **101** may be configured to be situated within the work area in a variety of ways. For example, it may simply rest on a work surface, in which case the air inlet advantageously is at the bottom, with the bottom surface raised from the work surface to allow air to enter. As another example, the appliance may be suspended from a work surface such as a bookshelf by means of a slot, located below, but near the upper surface of the appliance, which hooks over a portion of the shelf. In such configuration, the air intake would be on the bottom of the appliance. As yet another example, mounting holes or mounting brackets could be supplied serving to permanently attach the appliance to a convenient surface in the work area.

Another example is to configure the housing and the internal organization of the appliance to mount on and around the periphery of a computer monitor. FIG. **3** shows such a device. The personal environment appliance **302** rests on top of the computer monitor **301** and, as shown, has the main outlet ports **303** to the side of the monitor. User controls **304** are conveniently located above the top of the monitor **301** on the front face of the appliance **302**. In this example, air **305** enters at the top of the appliance **302**. Conditioned air **306** exits to the front from the main outlet ports **303** while waste air exits out the back (not shown) in this embodiment. Waste air could be directed to another area in another embodiment. In one embodiment, an anti-glare screen could be provided with the appliance to cover the computer screen.

Other features may be added to the thermoelectric personal environment appliance. In the examples of the appliance suspended from or attached to work place furniture, in one embodiment, a light is added to provide illumination of a work surface below the appliance. Preferably, the light is fluorescent to minimize heat generation and provide diffused light. FIG. **4** shows the addition of a beverage heater and cooler. The housing **301** is modified to include, as an example, the platform **402** within which is a substantially circular recess **403** sized to fit typical cups, mugs, or cans. Within the recess **403** is a thermoelectric module **404**. Within the housing **401**, and attached to the underside of the thermoelectric module **404** is a heat exchanger (not shown) located so that the waste air pathways (suitably modified) include the heat exchanger. User operable controls **405** for choosing heating or cooling and for the amount of the chosen heating or cooling are located on, or protrude from the housing **401**. The beverage heater/cooler portion of the appliance can be powered by the same power supply as powers the climate control portion or it can be separate.

The use of sound machines is well known to be beneficial in producing a calming and pleasant environment. The fan of the personal environmental appliance disclosed above produces a slight noise and, by suitable design, can be adjusted in amplitude and character. In addition, speakers may be added to the appliance to generate sound from an external signal source such as a computer CDROM drive and sound card. The speakers are powered either by the power supply **105** or by an external supply. The speakers or yet a separate sound system may be added to cancel unwanted noise either from the environment or noise emanating from the device itself. These configurations can be within the framework of those described above or can be integrated with a configuration designed to be mounted on a computer monitor as shown in FIG. **3** modified to extend the side arms enough to accommodate the speakers.

By taking advantage of the presence of the thermoelectric cooling present in the appliance, a small refrigerator may be added. In operation for personal heating or cooling, cool air is always generated whether on the main or the waste side. A portion of this air may be routed to an insulated box suitable for holding a small quantity of food or beverages, augmenting the number of thermoelectric elements and the capacity of the DC power supply as needed to supply the additional cooling required. In this configuration, the user controls are configured to allow the user to control the personal heating and cooling as desired while leaving the refrigerator running. To route cool air to the refrigerator regardless of the state of the heat/cool control, an electrically operated valve or vane, for example, is operated in response to the heat/cool switch setting to obtain the cool air from the proper duct. When the user has turned off the personal heating or cooling, the thermoelectric module and fan are under the control of a standby circuit by which the proper amount of air circulation and power to the TE module are determined and adjusted on the basis of a temperature measurement, by a thermistor, for example, of the refrigerator compartment.

A workspace or work area organizer feature may be added to the appliance. For example, this is an appendage to the housing with compartments for writing implements, memo pads, and other materials commonly found in the work place.

FIG. **5** depicts another particular embodiment, in cross section, of a thermoelectric personal environment appliance designed to be placed on a work or other surface **501**. A housing **502** encloses an optional filter **503** (preferably replaceable), a fan **504** with fan motor **505**, several inserts **506**, together forming main side duct **507** and waste side duct **508**. Advantageously, the inserts are insulative. A thermoelectric module **509** is located between the main side duct **507** and the waste side duct **508** and is in good thermal contact with a main side heat exchanger **510** residing within the main side duct **507** and a waste side heat exchanger **511** residing within the waste side duct **508**. Preferably, a flow director **512** is positioned within the left hand end of the main side duct **507** as shown in the figure. Electricity to power the thermoelectric device **509** and the fan motor **505** is supplied from AC power through cord and wall plug **513**. User operable controls **514** allow the user to choose on/off, cool/heat, and high/low.

Air enters the housing at its base through one or more ports **515** in the housing **502**. The air passes through the filter **503**, being drawn in by the fan **504**. The air leaving the fan enters the main side duct **507** and the waste side duct **508** so as to pass through the main side heat exchanger **510** and the waste side heat exchanger **511** in opposite directions as shown. By rearrangement of the ducts **507** and **508**, the flow can also be in the same direction. Advantageously, the assembly consisting of the thermoelectric module **509**, the main side heat exchanger **510**, and the waste side heat exchanger **511** are constructed with thermal isolation in the direction of flow as described above in FIG. **2**.

A small motor cooling duct **516** leads off the waste side duct **558** prior to its entrance to the waste side heat exchanger **511** and supplies air to cool the motor **505**. After passing around the motor **505**, the air leaves the motor cavity via another small motor air exit duct **517** that rejoins the waste side duct **508** after the waste side heat exchanger **511**. All of the air passing through the waste side duct **508** is expelled from the device through vents **518** positioned advantageously to direct the air away from the side of the device where the flow director **512** is located. As shown in FIG. **5**, that direction is normal to the plane of the cross-section.

Air within the main side duct **507** passes through the main side heat exchanger **510** where it is cooled or heated according to the setting of the user operable controls **514**. Air leaving the main side heat exchanger **510** passes through the flow director **512** that the user may adjust to direct the flow according to desires.

Preferably, the fan motor **505** is a two speed, AC fan and the DC for the thermoelectric module **509** is produced from the AC according to methods known in the art, such as full wave (user operable controls **514** set to high) or half wave (user operable controls **514** set to low) rectification without the need for filtering.

Several filtration systems can be used to improve the quality of air conditioned by the appliance in all the configurations of the present invention. Electrostatic filtration is well known to the art and can be incorporated in either the stream of the conditioned air or within the inlet so that both the conditioned and waste air are filtered. Alternately, electrostatic filtration may be used for the same purposes. Organic vapors and other contaminants can be removed by incorporating an absorptive filter medium such as an activated charcoal, or a combination of several media with complementary absorptive properties. Alternately, humidity, air freshening aromas, cleansing agents, disinfectants and/or other air modifiers can be added to the air streams to improve system functionality. The filter may also include ionic functionality

The conditioned air can be controlled in any of the devices herein in several ways. The air can be guided so as to sweep periodically through an angle, such as by automatically swiveling the nozzle back and forth. The outlet can be provided with the capability of focus in the conditioned air into a narrow angle, or dispersed over a broad angle by incorporating a suitable diffuser mechanism into the nozzle, for example as has been done in some aircraft passenger ventilator systems. Provisions can be designed to allow the air output direction to be manually adjusted.

In some circumstances, it may be desirable for the appliance to operate during a specific period of time, or to turn itself off after a given amount of time has elapsed. To provide this capability, a timer control mechanism including a clock is incorporated into the appliance control system **106**. A user either sets the times the appliance is to start and stop, or alternately, the user sets the length of time the appliance is to operate, with the appliance turning itself off when the specified time has elapsed.

As an additional feature, a clock and alarm is incorporated into the appliance. An additional configuration of the appliance is to integrate the appliance into the base of a freestanding desk lamp, combining the functionality of the two devices. Various configurations of the appliance could be integrated in this manner.

Although various specific embodiments of the present invention have been disclosed, the embodiments are not intended to limit, but only illustrate examples of the present invention. Accordingly, many other configurations and uses are possible. Accordingly, the inventions are not limited to any particular embodiment, or specific disclosure. Rather, the inventions are defined by the appended claims, in which terms are presented to have their ordinary and accustomed meaning.

What is claimed is:

1. A personal environment appliance that provides heating, cooling, or both heating and cooling in a localized area, the personal environment appliance comprising:

at least one electric motor driving at least one fan;

at least one inlet air path to a low pressure side of the at least one fan;

at least one thermoelectric device comprising a plurality of thermoelectric elements which together produce a source of heating and a source of cooling;

at least one heat exchanger in thermal communication with the at least one thermoelectric device, wherein air flows along the heat exchanger in a direction of flow and changes temperature, the heat exchanger comprising a plurality of heat exchanger elements in thermal communication with at least one of the source of heating and the source of cooling of the at least one thermoelectric device such that each heat exchanger element of the plurality of heat exchanger elements has a corresponding temperature and is in thermal communication with the air, the plurality of heat exchanger elements extending away from the side and substantially thermally isolated from one another in the direction of flow such that at least one of thermoelectric elements of the plurality of thermoelectric elements is substantially thermally isolated from the other thermoelectric elements of the plurality of thermoelectric elements in the direction of flow, such that the at least one thermoelectric device and the at least one heat exchanger improve thermodynamic efficiency of the appliance by reducing temperature differences between the air flowing along the heat exchanger and the corresponding temperature of the heat exchanger element; and

at least one outlet for air that has passed the heat exchanger to provide temperature control of the localized area.

2. The personal environment appliance of claim **1**, including at least one insulative member shaped to provide the at least one inlet air path.

3. The personal environment appliance of claim **1**, further comprising at least one air filter demountably disposed to air.

4. The personal environment appliance of claim **1**, further comprising at least one flow directing device for the at least one outlet.

5. The personal environment appliance of claim **1**, further comprising a user operable control.

6. The personal environment appliance of claim **5**, wherein the user operable control adjusts the air flow rate.

7. The personal environment appliance of claim **5**, wherein the user operable control selects heating or cooling.

8. The personal environment appliance of claim **5**, wherein the user operable control adjusts the amount of heating or cooling.

9. The personal environment appliance of claim **1**, further comprising a thermoelectric beverage cooler and heater.

10. The personal environment appliance of claim **1**, wherein the appliance is constructed to mount on a computer monitor.

11. The personal environment appliance of claim **10**, further comprising an anti-glare screen positioned in front of the computer monitor.

12. The personal environment appliance of claim **1**, further comprising a thermoelectric refrigerator.

13. A method of providing heating, cooling, or both heating and cooling in a localized area, the method comprising:

providing a personal environment appliance comprising:

at least one electric motor driving at least one fan;

at least one inlet air path to a low pressure side of the at least one fan;

at least one thermoelectric device comprising a plurality of thermoelectric elements which together produce a source of heating and a source of cooling;

at least one heat exchanger in thermal communication with the at least one thermoelectric device, wherein air flows along the heat exchanger in a direction of flow and changes temperature, the heat exchanger comprising a plurality of heat exchanger elements in thermal communication with at least one of the source of heating and the source of cooling of the at least one thermoelectric device such that each heat exchanger element of the plurality of heat exchanger elements has a corresponding temperature and is in thermal communication with the air, the plurality of heat exchanger elements extending away from the side and substantially thermally isolated from one another in the direction of flow such that at least one of thermoelectric elements of the plurality of thermoelectric elements is substantially thermally isolated from the other thermoelectric elements of the plurality of thermoelectric elements in the direction of flow, such that the at least one thermoelectric device and the at least one heat exchanger improve thermodynamic of the appliance by reducing temperature differences between the air flowing along the heat exchanger and the corresponding temperature of the heat exchanger element; and

at least one outlet for air that has passed the heat exchanger to provide temperature control of the localized area; and

controlling the amount of heating or cooling of the localized area by adjusting the air flow rate and the temperature of the air.

14. A personal environment appliance that provides heating, cooling, or both heating and cooling in a localized area, the personal environment appliance comprising:

means for propelling air;

first means for guiding air to the air-propelling means;

thermoelectric means for creating a temperature differential comprising a plurality of thermoelectric elements which together produce a source of heating and a source of cooling;

means for exchanging heat between the thermoelectric means and air, wherein air flows along the heat-exchanging means in a direction of flow and changes temperature, the heat-exchanging means comprising a plurality of heat exchanger in thermal communication with a at least one of the source of heating and the source of cooling of the thermoelectric means such that each heat exchanger element of the plurality of heat exchanger elements has a corresponding temperature and is in thermal communication with the air, the elements extending away from the side and substantially thermally isolated from one another in a direction of air flow such that at least one of thermoelectric elements of the plurality of thermoelectric elements is substantially thermally isolated from the other thermoelectric elements of the plurality of thermoelectric elements in the direction of flow, such that the thermoelectric means and the means for exchange heat improve thermodynamic efficiency of the appliance by reducing temperature differences between the air flowing along the means for exchanging heat and the corresponding temperature of the heat exchanger element; and

second means for guiding air from the heat-exchanging means to the localized area.

15. The personal environment appliance of claim **14**, wherein the thermoelectric means comprises a thermoelectric element having a first side and a second side, the plurality of elements comprising a first set of elements in thermal communication with the first side of the thermoelectric element, the first set of elements substantially thermally isolated from one another in the direction of air flow.

16. The personal environment appliance of claim **15**, wherein the plurality of elements further comprises a second set of elements in thermal communication with the second side of the thermoelectric element, the second set of elements substantially thermally isolated from one another in the direction of air flow.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,069,674 B2
APPLICATION NO. : 12/100285
DATED : December 6, 2011
INVENTOR(S) : Lon E. Bell

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

At Column 9, Line 7, claim 13, please change “thermodynamic of” to --thermodynamic efficiency of--.

At Column 9, Line 32, claim 14, please change “exchanger” to --exchanger elements--.

Signed and Sealed this
Thirty-first Day of July, 2012

David J. Kappos
Director of the United States Patent and Trademark Office